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POSSIBLE CAUSES OF THE DECLINE IN NUMBERS OF NOISY SCRUB-BIRDS NEAR LAKE GARDNER, TWO PEOPLES BAY, 1988.

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SUMMARY

Singing male Noisy Scrub-birds declined in numbers south and south-west of Lake Gardner in 1987/88. The present study demonstrated that this decline is unlikely to have been caused by rodent predation or avian disease. There is slender evidence to suggest that food supply on its own is not implicated. It is possible that the decline was caused by the dry conditions in the spring of 1987 affecting Scrub-bird numbers in sub-optimal habitats only. These conclusions, together with the discovery of several Scrub-birds still occurring south and west of Lake Gardner, suggest that the best course of action at the present time would be to proceed as normal until the 1989 census. Recommendations are made as to monitoring activities which might be done in connection with the 1989 census.

INTRODUCTION

Censuses of singing male Noisy Scrub-birds (Atrichornis clamosus) are carried out each winter in the Mt Gardner and Lake Gardner - Moates Lake areas in the Two Peoples Bay Nature Reserve (Danks 1988). Noisy Scrub-birds were first recorded on the lower reaches of Gardner Creek in 1973 (Smith 1985) and near Lake Gardner by 1978 (CALM records). The population of singing males increased to 64 in these areas in 1987 (Fig. 1). Since 1980 the Mt Gardner population of singing males has been expanding at a slower rate than previously. Presumably this is because all suitable habitat became occupied and 'excess' males became subdominant individuals within the territories of breeding males (A. Danks, personal communication) or dispersed to other areas. Dispersal from Mt Gardner to the lakes area has no doubt contributed to the rapid expansion of the lakes population up until 1987. In 1988, however, censuses revealed a drop in number of about 30 singing males in the lakes area. Furthermore, the loss of males was not spatially random within the population - no males could be located to the south of Lake Gardner and many of those to the south-west and west could not be located either, although all males on the northern side of Lake Gardner could be located. The apparent complete loss of singing males from some areas was clearly a matter of some concern (Danks 1988).

A number of hypotheses have been put forward to explain this drop in numbers (Danks 1988). The following were thought to be worthy of consideration at this point:

1) the observed pattern is due to stochastic events alone
2) a specialist bird predator (probably cat or fox) has been operating in the area

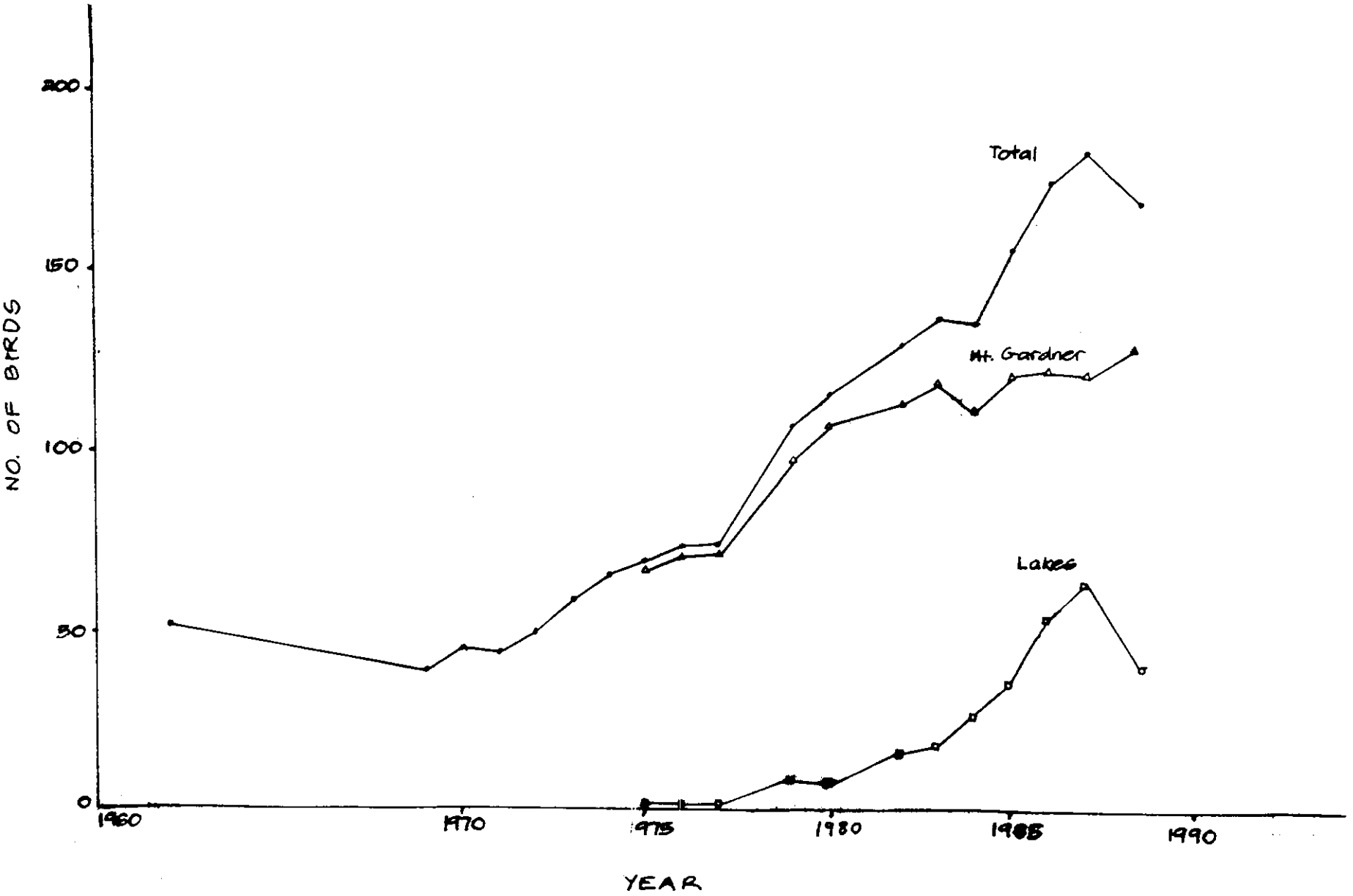


Figure 1: Numbers of singing male Noisy Scrub-birds located during censuses at Two Peoples Bay since 1962 (data from CALM records)

3) a rodent plague has resulted in extra-ordinary predation by rodents
4) an avian disease is affecting small insectivores in the lakes area
5) there has been a dramatic and localized drop in the Noisy Scrub-bird food supply
6) Scrub-bird population size is determined by climatic events.

It was the aim of the present study to examine hypotheses 3), 4), 5) and 6); hypothesis 2) is being tested by D. Algar.

Advice from an avian pathologist (Dr D. Pass, Murdoch University Veterinary School) suggested that if a disease was involved, then it would be likely to affect a number of bird species, not just Noisy Scrub-birds (Danks 1988). If other species were also affected, then the effects should be most noticeable in (sedentary) territorial passerine insectivores. One aim of the present study therefore was to census such species in an area where Noisy Scrub-birds had been lost and in an adjacent area containing a healthy population of Scrub-birds.

Further aims were to trap for rodents and to sample for litter invertebrates in these same areas and on Mt Gardner.

MATERIALS AND METHODS

Assessment of Small Mammal Numbers

Small mammals were trapped by means of large (45 x 16 x 15 cm) and medium (32 x 10 x 8 cm) box traps ('Elliotts'). Numbers of traps per site are shown in Table 1. Traps were placed in two adjacent sites differing with respect to Scrub-bird numbers - sites 1 (+NSB, i.e. with Scrub-birds) and 2 (-NSB, i.e. without Scrub-birds) (Fig. 2). Additional traps were placed in a gully on Mt Gardner where Noisy Scrub-birds have been permanently resident for some years (site 3), and at two other sites where Scrub-birds are known to occur - to the north of Lake Gardner (site 4) and near the eastern end of Moates Lake (site 5) (Fig. 2). Trapping was done from 12 to 16 September.

Bird Censusing

Passerine insectivores were censused on both the north-eastern and south-eastern sides of Lake Gardner. Two methods were used - the variable circular plot method (Reynolds et al. 1980, Pyke and Recher 1985) and the variable width strip transect method (Emlen 1971, 1977). Access was difficult through the centre of the Noisy Scrub-bird areas due to the density of the vegetation. In the present study, therefore, a transect was selected on the edge of the dense vegetation and birds counted on one side only of the transect or circular plot. On each side of the lake (sites 1 (+NSB) and 2 (-NSB) in Fig. 2), 10 plots were chosen at 100 m intervals and five minutes spent observing

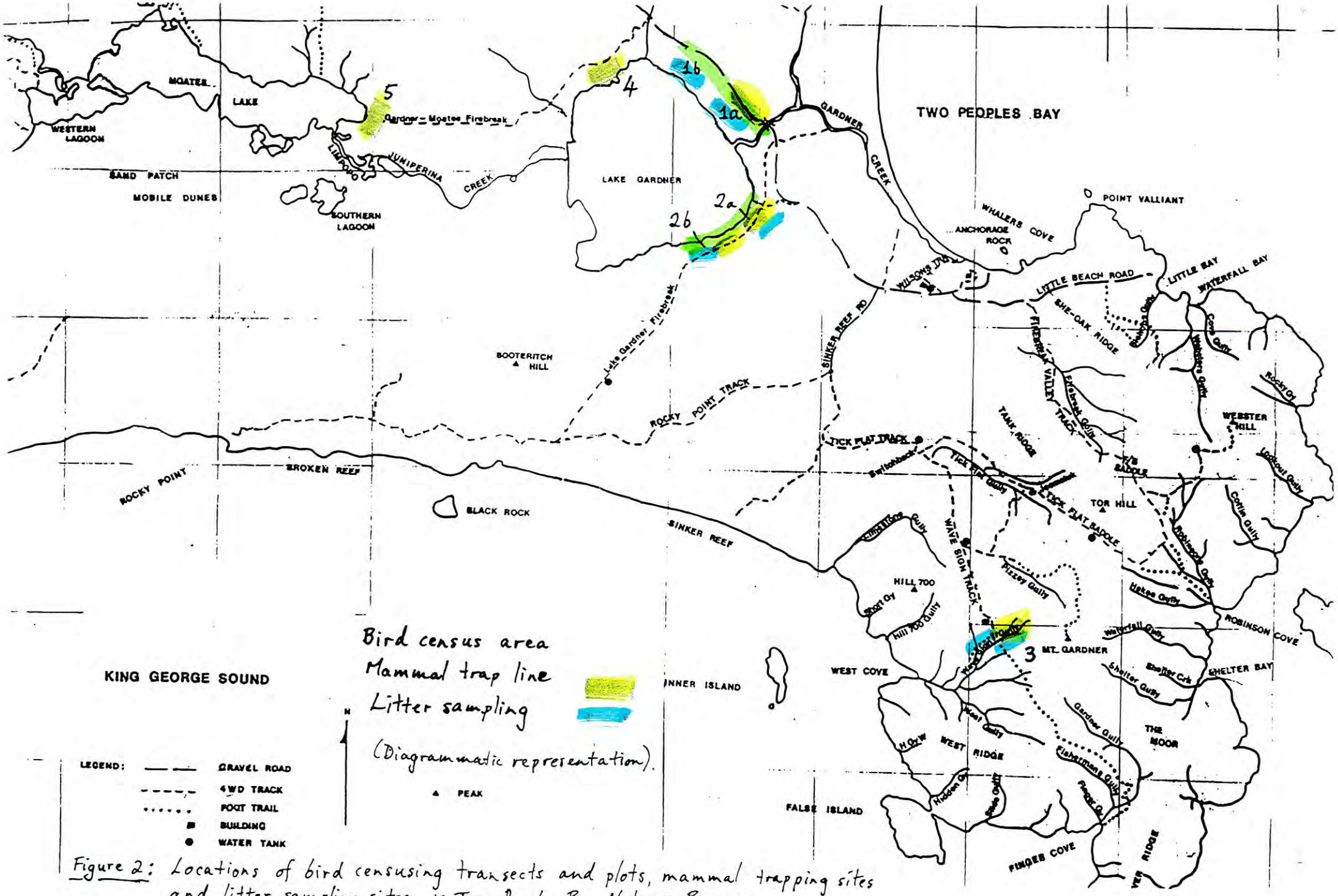


Figure 2: Locations of bird censusing transects and plots, mammal trapping sites and litter sampling sites at Two Peoples Bay Nature Reserve.

from the centre of each plot. The strip transect followed a route which included all circular plots and was surveyed while walking at an average rate of 20 m / minute between the circular plots. For all birds recorded, distance from the observer was estimated in the intervals 0-5, 5-10, 10-15, 15-20, 20-30, 30-40, 40-50 and greater than 50 m. The transect was walked (and plots visited) in reverse order on alternate days, to eliminate time of day as a variable. The same observer was involved in all the counts. Counts were commenced between 0650 and 0730 and completed by 1110 on each of 13, 14, 15 and 16 September 1988.

The vegetation structure at the two bird census sites was different. At the -NSB site, vegetation near the lake consisted of mid-dense to dense Agonis juniperina to 7 m with scattered Banksia littoralis over dense Lepidosperma sp(p) and Gahnia sp. to 1.5 m. Further from the lake, vegetation consisted of mid-dense A. flexuosa over patches of Lepidosperma sp(p) and sparse mixed shrubs. In the +NSB area, vegetation varied from dense Melaleuca sp. (paperbark), A. juniperina and occasional A. flexuosa and B. littoralis to 5 m over an understorey of young plants of the above species of mixed heights and including dense clumps of Lepidosperma sp., to areas with dense A. juniperina from 2 - 4 m, sometimes with patches of Oxylobium lanceolatum to 3.5 m, over dense sedges to 1 m, sometimes with shallow surface water.

Food Supply

Scrub-birds forage for invertebrates in the litter and lower shrub layers (Smith 1985). In the short time available in the present study, it was only possible to sample litter invertebrates. Because Scrub-birds include saltational species such as Orthopterans in their diet (Smith and Calver 1984) a total litter collection method was used in favour of pit trapping. As the vegetation was extremely dense in some areas, it was necessary to use a small quadrat size to sample litter. The size chosen was 20 x 20 cm which conforms with earlier work done on litter invertebrates in the Two Peoples Bay Nature Reserve (Smith and Calver 1984). Litter was collected from 10 quadrats at each of six areas - two at each of sites 1, 2 and 3. All invertebrates greater than 1.5 mm in length were separated from the litter by hand sorting.

Rainfall

Rainfall data (monthly decile range numbers) were obtained from published monthly rainfall reviews (Bureau of Meteorology, 1969-1988). Rainfall patterns were compared by eye with patterns of census numbers for singing male Scrub-birds.

RESULTS

Small Mammal Numbers

The Bush Rat (Rattus fuscipes) was the only Rattus species captured. It was found to be common at all sites except site 4 (Table 1) and was equally common at sites 1 (+NSB) and 2 (-NSB). Bush Rats were most commonly caught on Mt Gardner, in a gully which has been long inhabited by Scrub-birds (site 3). The majority of animals caught (90%) were adults and the remainder were subadult or not determined.

No introduced rodents were caught at any site.

The only other mammal species captured was the Yellow-footed Antechinus (Antechinus flavipes), trapped in low numbers at two sites (Table 1).

Site	No. of trap nights		Species			
			Rattus fuscipes			Antechinus
	M	L	Total	Min. No.	Min.No/trap night x 100	No.
1	84	20	22	9	8.6	0
2a	88	40	15	12	9.4	1
2b	80	20	11	9	9.0	0
3	60	30	18	13	14.4	1
4	60	30	0	0	0	0
5	75	30	22	13	12.4	0

Table 1: Results of mammal trapping at Two Peoples Bay. M = medium Elliotts; L = large Elliotts; Total = total number of captures; Min. No. = minimum number of different animals caught at that site.

Bird Censusing

The species composition of the bird communities at the two census sites was quite similar (Table 2). As judged by the frequency with which each species was recorded as being present at sample plots or transect segments, no species were common at one site and absent from the other and those species present at only one site were quite uncommon at that site.

There are three species for which there are obvious discrepancies in frequencies of recording between sites - Noisy Scrub-bird, New Holland Honeyeater and Western Spinebill. The New Holland Honeyeater appeared to be displaying a habitat preference for site 2 (-NSB area). This species is larger than the Spinebill and is presumably excluding it from this area but not from site 1 where the New Holland Honeyeater is less common (c.f. Ford 1979).

Bird species		Circular plots		Transects	
Common Name	Scientific Name	No of points +NSB	-NSB	No of segments +NSB	-NSB
Spotless Crake	Porzana tabuensis	3	Ø	1	Ø
Red-capped Parrot	Purpureicephalus spurius	Ø	5	3	1
Western Rosella	Platycercus icterotis	1	Ø	Ø	Ø
Shining Bronze-Cuckoo	Chrysococcyx lucidus	5	2	3	4
Noisy Scrub-bird	Atrichornis clamosus	2Ø	Ø	1Ø	1
Golden Whistler	Pachycephala pectoralis	6	4	4	3
Grey Fantail	Rhipidura fuliginosa	32	2Ø	34	21
Red-winged Fairy-wren *	Malurus elegans *	15	13	17	7
Southern Emu-wren	Stipiturus malachurus	3	Ø	2	Ø
White-browed Scrubwren	Sericornis frontalis	14	19	11	16
Western Gerygone	Gerygone fusca	Ø	1	Ø	Ø
Inland Thornbill	Acanthiza apicalis	8	11	1Ø	5
Red Wattlebird	Anthochaera carunculata	Ø	2	1	1
Little Wattlebird	Anthochaera chrysoptera	Ø	4	1	3
New Holland Honeyeater	Phylidonyris novaehollandiae	2	17	1	1Ø
Western Spinebill	Acanthorhynchus superciliosus	17	5	12	4
Silvereye	Zosterops lateralis	16	21	15	22
Grey Currawong	Strepera versicolor	Ø	1	Ø	Ø
Australian Raven	Corvus coronoides	2	1	5	Ø

* Includes a few M. splendens on the +NSB transect.

Table 2: Bird species recorded at each of the two censusing sites in Two Peoples Bay Nature Reserve, September 1988. Numbers (maximum possible 4Ø) are the number of plots (transect segments) in which that species was recorded within 5Ø m of the observer.

Numbers of the four most common birds encountered in each census area are shown in Table 3. These data are insufficient to make reliable population density estimates as the sample sizes per species are too small to calculate meaningful distance/density curves. However, the data are still usefull for making comparisons of relative abundance, provided that it is realized that differences in vegetation densities at the two sites would result in changes of conspicuousness within species between sites and also between species. In the present study, because the vegetation was so dense, most records were based on calls rather than on sight records and so this problem would be minimized. Bearing these considerations in mind, comparisons of abundance can be made between sites within techniques for the common species. Little difference is apparent in the numbers of the four common species between

Species	Census	Cumulative no's in distance category						
		5	10	15	20	30	40	50
WBSW	+C	1	2	3	7	9	13	14
	-C	0	3	7	9	17	19	20
	+T	0	2	3	6	10	11	12
	-T	0	1	7	10	17	19	19
Fairy-wren	+C	4	15*	18	26	27	28	28
	-C	1	5	8	11	15	16	16
	+T	2	5	11	16	17	19	19
	-T	0	2	6	6	8	8	8
GFT	+C	4	9	12	18	24	37	47
	-C	4	9	13	17	19	23	26
	+T	1	5	7	12	27	39	42
	-T	6	11	12	16	22	27	28
S/e	+C	0	0	2	6	14	20	20
	-C	0	3	3	11	21	22	22
	+T	1	6	11	14	23	25	27
	-T	0	7	11	23	29	29	30

* Strongly biased by the recording of a single large group.

Table 3: Cumulative numbers of individual birds recorded in distance categories (see Methods). (WBSW = White-browed Scrub-wren; Fairy-wren = Red-winged Fairy-wren (except for a few Splendid Fairy-wrens in the large group referred to above); GFT = Grey Fantail; S/e = Silvereye; + = site 1 (+ Scrub-birds); - = site 2 (- Scrub-birds); C = circular plot; T = transect counts; distance category 5 = 0-5 m, etc).

sites as shown by both census methods (Table 2). For each technique, patterns of detection were very similar within each of these species.

Food Supply

The numbers of invertebrates found varied tremendously between samples but did not differ greatly between sites 1 (+NSB) and 2 (-NSB) (Fig. 3). There did, however, appear to be more invertebrates per quadrat in site 3 on Mt Gardner.

Preliminary sorting of the animals collected (Table 4) revealed no really substantial differences in litter invertebrate community structure between sites except that spiders were relatively less common at site 2 (-NSB). Ants were variable in occurrence and absent from site 1b because it was waterlogged. More detailed examination of the collection would no doubt reveal further differences.

Taxon	Site					
	1a	1b	2a	2b	3a	3b
Araneida	2Ø	4Ø	14	9	33	19
Blattodea	1Ø	Ø	2	Ø	Ø	1
Orthoptera	Ø	Ø	Ø	Ø	Ø	Ø
Formicoidea	3Ø	Ø	8	35	7	2Ø
Others	4Ø	6Ø	77	56	6Ø	6Ø

Table 4: Composition of the litter invertebrate communities (percentages of animals at that site) in the study sites at Two Peoples Bay, based on preliminary sorting of the collections.

Measurement of dry weights of litter collected from each quadrat (Fig. 3) suggest that areas with more litter have more invertebrates, but the relationship has not been tested statistically.

Rainfall

Monthly rainfall records (Bureau of Meteorology 1969-1988) are shown in Fig. 4. There is no obvious relationship between numbers of Scrub-birds and variation in monthly rainfall. There is a suggestion in the data that numbers may drop following very much below average (decile number 1) rainfall in September or October, but the pattern is not consistent. The 197Ø count, for example, is higher than the 1969 count, despite the fact that winter and spring of 1969 were extremely dry (Fig. 4).

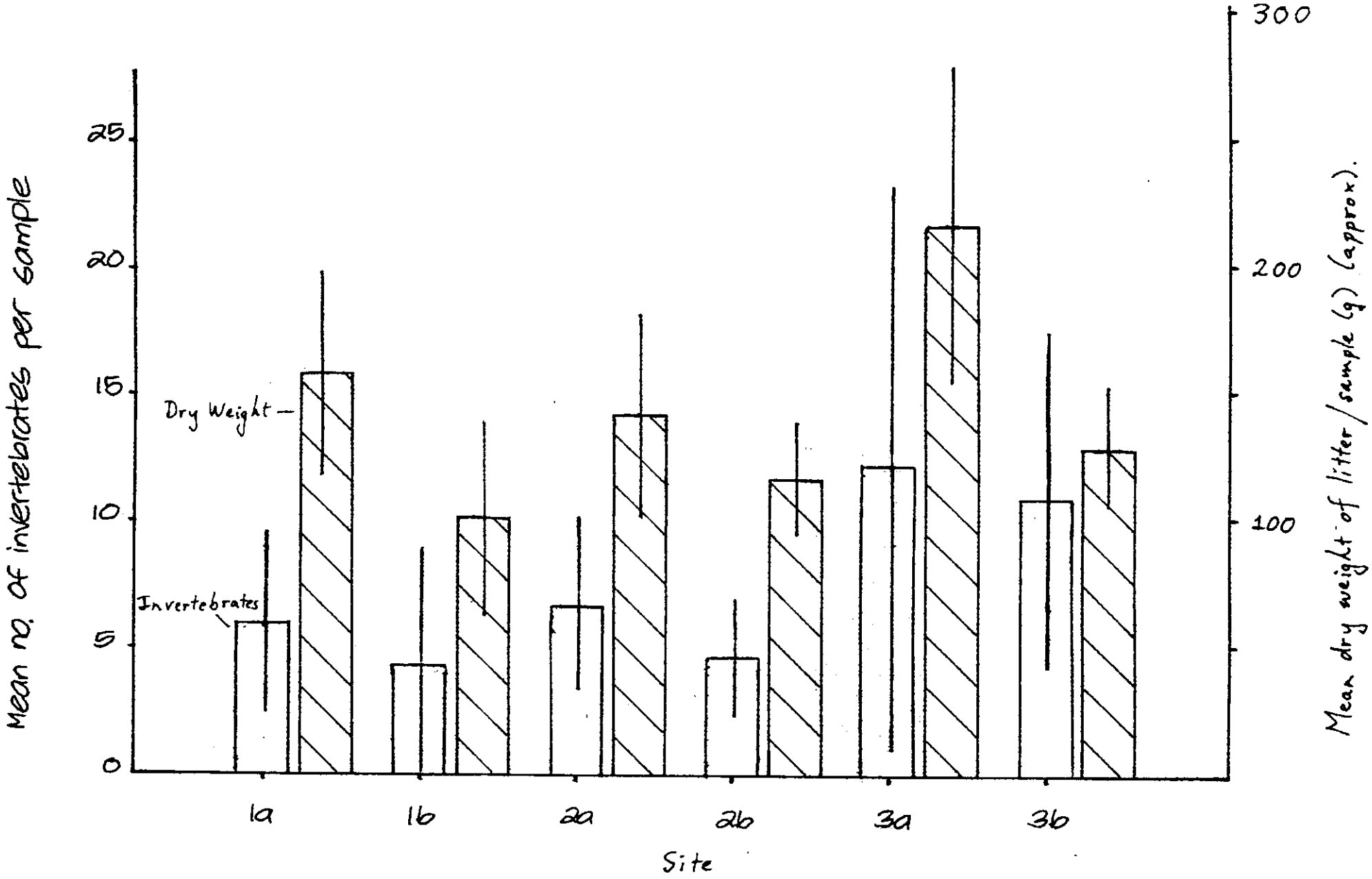


Figure 3: Mean dry weight of litter and mean number of invertebrates per 400 cm² quadrat from 10 quadrats per site at Two Peoples Bay Nature Reserve.

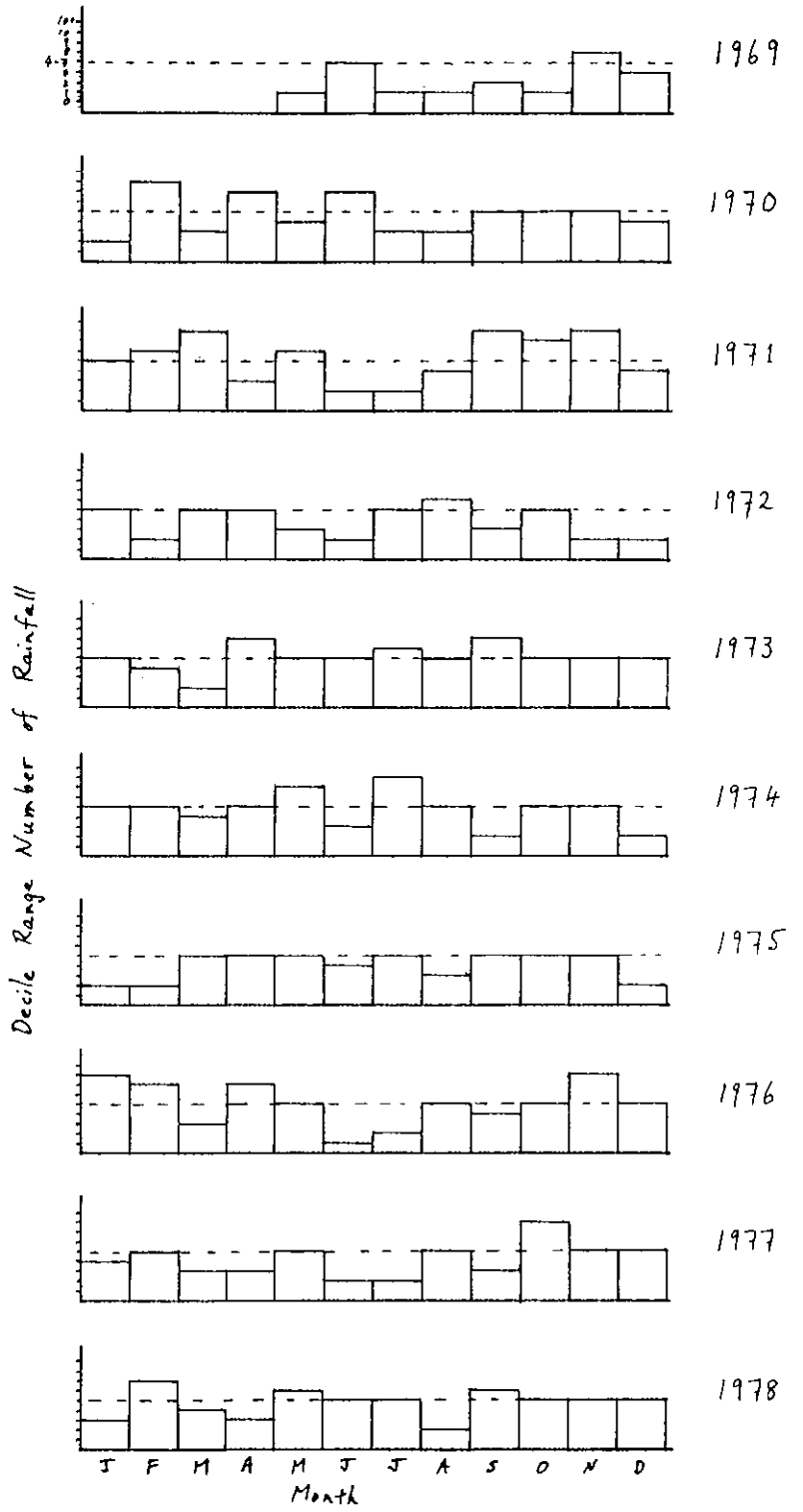

1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
Decile Range Number of Rainfall
J F M A M J J A S O N D
Month

Figure 4(a)

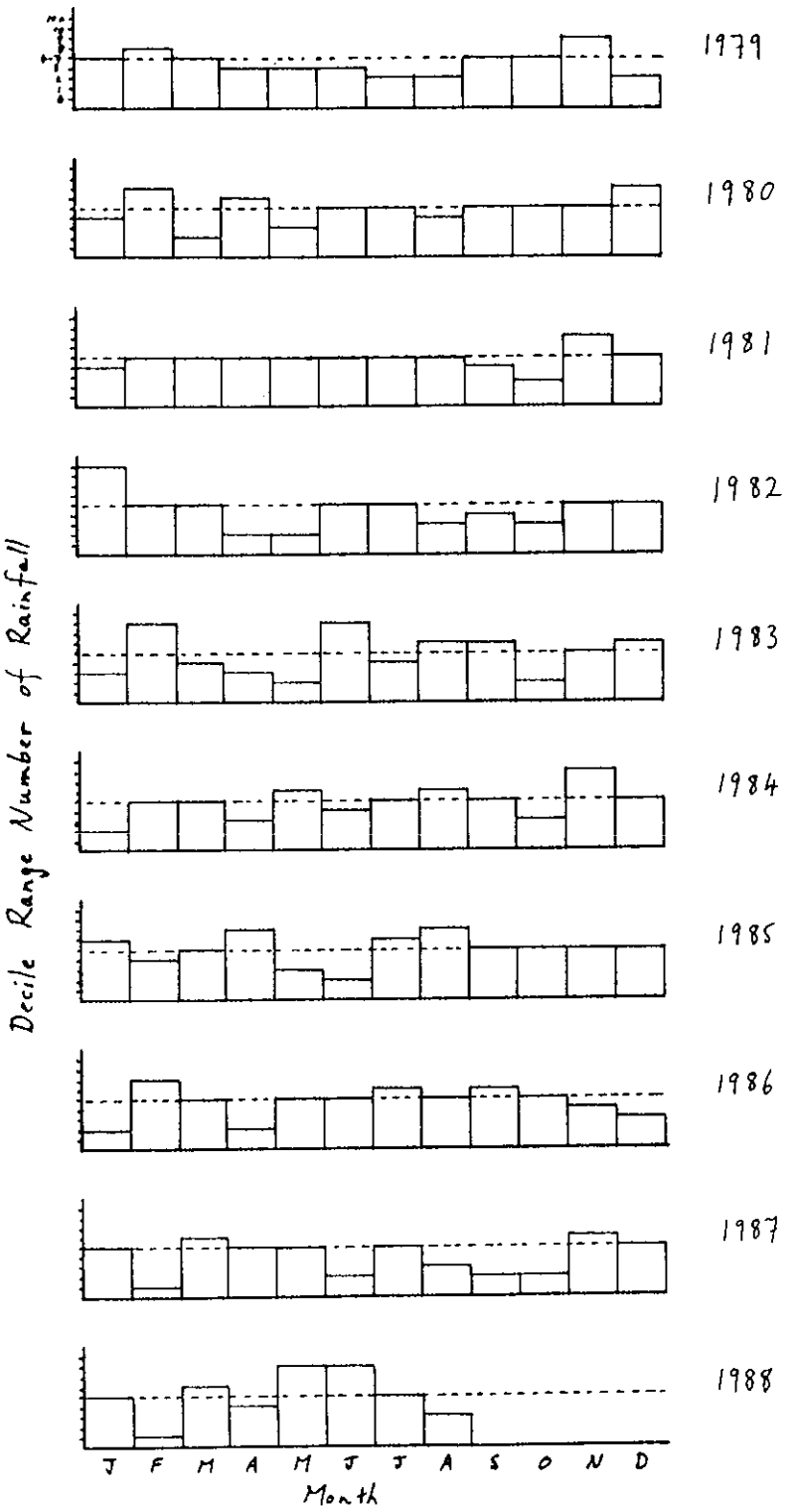


Figure 4: Monthly decile range numbers of rainfall for the Two People Bay area, 1969 - 1988. Data from Bureau of Meteorology (1969 - 1988).

DISCUSSION

Small Mammals

Overall, the trapping data suggest that small mammals are not implicated in the decline in numbers of Noisy Scrub-birds in the lakes area at Two Peoples Bay. The distribution and abundance of Bush Rats recorded in this study indicates strongly that they are not implicated. Bush Rats on the South Coast are seasonal breeders, with young being produced from October to mid-January (Kitchener et al. 1975). The small number of young encountered in the present study (< 10%) suggests that this species has not undergone a recent rapid increase in numbers. Furthermore, the similarity in capture rates between sites differing in Scrub-bird population changes argues against rats being involved in causing these changes.

Antechinus is much more difficult to trap than Rattus, but the very low numbers caught suggest that they are not sufficiently abundant to be major predators of Scrub-birds.

In any case, no introduced species of small mammals were recorded and Scrub-birds in this area must have co-existed with native mammals including Bush Rats and the Yellow-footed Antechinus for thousands of years.

Birds

Of the bird species present at the study site, the White-browed Scrub-wren is ecologically the most similar to the Scrub-bird in that it inhabits dense undergrowth and feeds on invertebrates of the shrub and litter layers (Wooller and Calver 1981). Being strongly territorial and living in family groups (Ambrose 1985) they would be likely to succumb rapidly to any disease present in the population. Scrub-wrens, however, were at least as abundant in the -NSB area as in the +NSB area. Furthermore, the few Scrub-wrens which were seen clearly enough to determine their age were all adults, suggesting that they were permanent residents, rather than young birds which had recently dispersed into the area after residents had died.

The Red-winged Fairy-wren also forages on invertebrates in the shrub layer, holds permanent territories and roosts communally (Rowley 1983, Wooller and Calver 1981, R. and M. Brown, personal communication) and would therefore also be expected to be highly susceptible to disease. However, there were still relatively high numbers in the -NSB area, including a number of adult males in breeding plumage. In this species young females, but not young males, disperse from the natal territory and adults are permanent residents (Rowley 1983). The adult birds observed in the -NSB area, therefore, are likely to be permanent residents which lived in this area since before the decline in numbers of the Scrub-birds. This suggests strongly that disease was not responsible for the decline in Scrub-bird numbers.

The observed patterns of abundance in two other common passerines (Grey Fantail and Silvereye) and the similarity in species structure of the bird communities at the study sites support the conclusion that disease is unlikely to be a factor in the decline of Scrub-birds at site 2.

Food Supply

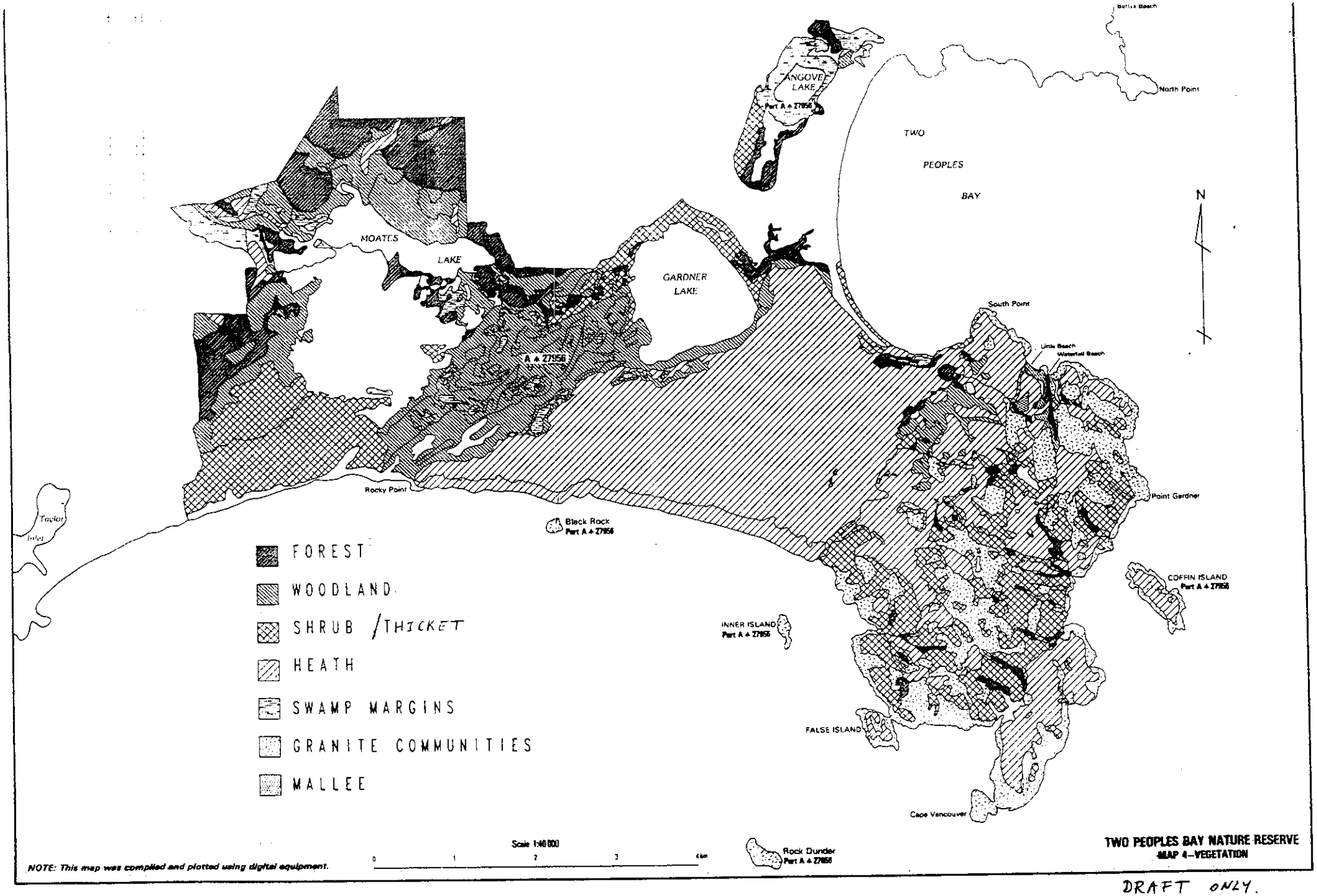
Assuming that litter invertebrates are a reliable index to Scrub-bird food supply, then poor food supply is unlikely to be the reason for the difference in Scrub-bird abundance between the -NSB and +NSB areas. On the other hand, the data do suggest that the food supply for Scrub-birds is much higher on Mt Gardner than in the lakes area. However, care should be taken in interpreting the invertebrate data because 1) litter invertebrates greater than 1.5 mm in length may not be a good index to the abundance of macro-invertebrates (Scrub-birds presumably only eat the larger invertebrates (Smith and Calver 1984, G.T. Smith, personal communication)), 2) Scrub-birds forage in the sedge and shrub layers as well as in litter (Smith 1985) 3) macro-invertebrates are more abundant in the bases of sedges than in the litter (G.T. Smith, personal communication) and 4) sampling was done in only one gully on Mt Gardner. It would be useful to know more about feeding requirements of adult Scrub-birds and about the abundance, distribution and phenological characteristics of invertebrate prey species.

Vegetation Structure

Vegetation in the +NSB area had a greater foliage height diversity and was more patchy than that at the -NSB site. Vegetation at both sites has obviously been suitable for survival of Scrub-birds in the past. However, preferred habitat of the Scrub-bird includes vegetation with considerable foliage height diversity (Smith 1985 and references therein) and it is of interest that Hopkins et al. (in preparation) have mapped the area in which the Scrub-birds have declined as being less similar to the Mt Gardner Scrub-bird habitat than is the vegetation in the area where they still occur in high numbers around the lakes (Fig. 5). It may well be that the vegetation in the area south and south-west of Lake Gardner is sub-optimal for Scrub-birds when compared with the vegetation north of the lake and along Juniperina Creek.

Climate

Smith (1987) has shown that Scrub-birds dropped in numbers during the two drought periods pre-1970 and 1983-84, but not in the very dry year of 1972. He concluded that the timing and extent of drought are of importance in the regulation of Scrub-bird numbers. The present study lends some support to this finding. In order to interpret these data, however, it would be useful to know the relationship between food supply and climatic variables. Koch and Majer (1980) and Majer and Koch (1982) found that litter invertebrates were generally more active in the spring and



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From: Hopkins, Williams + Brown (in prep.).

Figure 5: Draft vegetation map of Two Peoples Bay Nature Reserve.

summer months at three sites in south-western Australia, but the relationship with climatic variables was a complex one, with possible site variation superimposed. Spring may well be a critical time for Scrub-birds as this is presumably the time when young of the year are learning to survive on their own. In this context it is interesting to note that the current drop in numbers follows a relatively dry spring (Fig. 4). However, the dry winter and spring of 1969 was followed by an increase in numbers of Scrub-birds (Figs 1 and 4). If climate is important in regulating Scrub-bird numbers, then the relationship does not appear to be a simple one and may also be different in different habitats.

Perhaps the major factor confounding interpretation of the data is that Scrub-bird censuses only relate to numbers of singing males and this statistic may not be very closely related to total numbers of males or total numbers of birds. Either rather more census counts or a more precise census method will be needed to resolve this difficulty.

CONCLUSIONS AND RECOMMENDATIONS

The data presented here provide strong indirect evidence that neither rodents nor avian disease have played a major role in the decline in numbers of singing male Noisy Scrub-birds in the lakes area at Two Peoples Bay. Food supply, on it's own, is unlikely to be a factor, but may have been influenced adversely in some habitats during the dry spring of 1987. The decline in numbers in 1988 has occurred in what may be sub-optimal habitat compared with other areas near the lakes and on Mt Gardner. In the light of the above, together with the locating of two more male Scrub-birds in the area where they were thought to have disappeared (D. Grace, personal communication), the following recommendations are made:

1. No further extra-ordinary action be taken before the first census of early next winter(1989).

2. First priority for censuses in 1989 should be the Lake Gardner area.

3. If singing male Scrub-birds are absent from south and west of Lake Gardner in 1989, then consideration should be given to introducing several male Scrub-birds, one at a time, with radio transmitters attached so that their subsequent behaviour can be monitored.

4. If singing male Scrub-birds are absent from south and west of Lake Gardner in 1989, then consideration should be given to experimentally manipulating an area of vegetation in an attempt to make it more suitable for Scrub-birds. Such manipulation could include burning or slashing to encourage regrowth of Agonis juniperina in order to increase future foliage height diversity.

5. In future censuses, there should be instituted a formal system for immediate and ongoing mapping of census results to provide immediate visual assessment of apparent gaps in distribution. Highest priority should then be given to apparent gaps compared with the previous year's census. This should enable earlier warning of any possible future local declines in Scrub-bird numbers.

ACKNOWLEDGEMENTS

Jim Rolfe and Dan Grace provided much assistance in the field, particularly with respect to the mammal trapping aspects of this study and Penelope Proffitt drew figures 1, 2 and 3. Judith Harvey allowed me access to unpublished information on the vegetation of Two Peoples Bay and Bob Prince provided useful suggestions and information. Julie Raines provided useful comments on the manuscript.

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